COMBUSTION

DEVOTED TO THE ADVANCEMENT OF STEAM PLANT DESIGN AND OPERATION

November, 1946

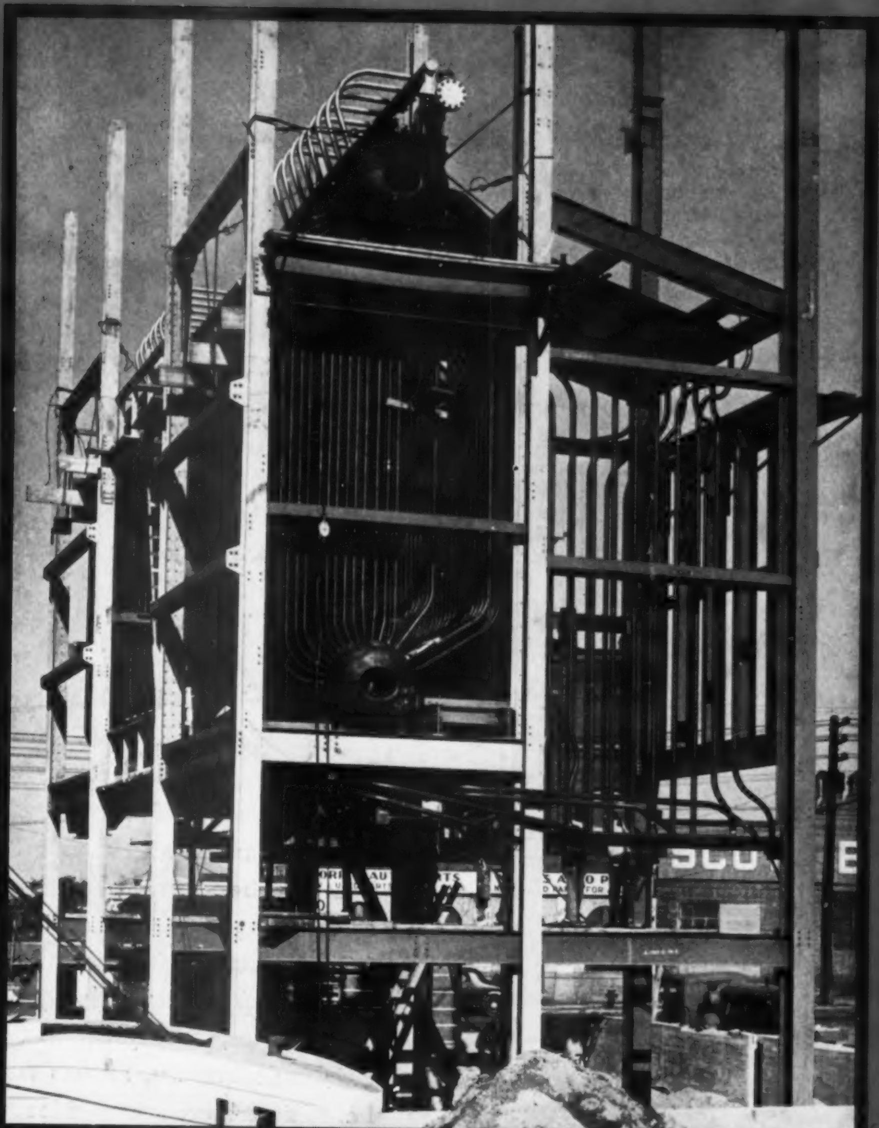

Photo by H. R. Towse

Industrial plant boiler before closing in

Trends in Ash- and Dust-Handling Systems ▶

Progress in Transformation of Energy ▶

COMBUSTION

DEVOTED TO THE ADVANCEMENT OF STEAM PLANT DESIGN AND OPERATION

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FOR NOVEMBER 1946

FEATURE ARTICLES

EDITORIALS

DEPARTMENTS

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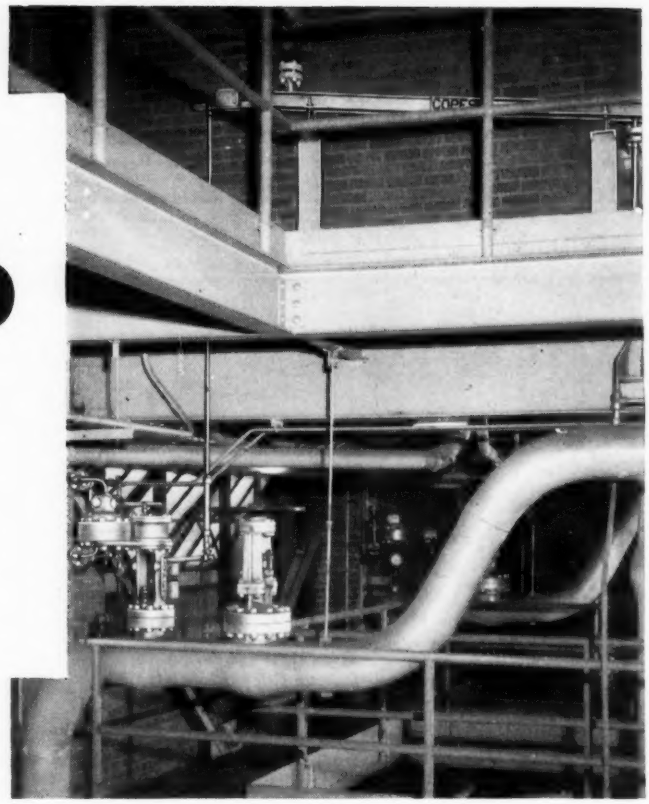
AT EASTERN UTILITY



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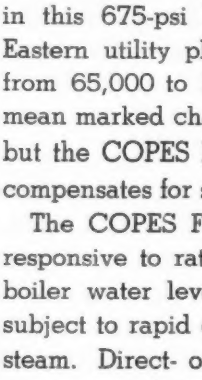

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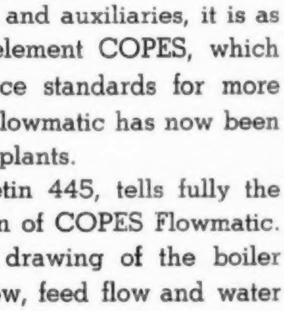


EDITORIAL

The Power Show

After a lapse of four years the New York Power Show will again be held at its old location in the Grand Central Palace, December 2 to 7. Following previous practice these dates will coincide with the Annual Meeting of the A.S.M.E.—a most convenient arrangement for out-of-town visitors.

It is anticipated that much new and improved equipment will be on display. Some of this will result from technological advances made during the war and since applied to peacetime practice. This is particularly true of such things as controls, the employment of new materials, etc.

These expositions have always held interest for power engineers concerned with design and operation, but this year there is likely to be special educational value for the many young men entering the field, either for the first time or after an extended absence while serving in the armed forces.

The timeliness of the show is emphasized by the large amount of new power plant work now in progress, and an unusually large attendance is expected.

Nuclear Research for Power Generation

Following appointment by the President of the Atomic Energy Commission, has come official announcement of the Government's plans to promote nuclear research and development for peacetime uses, including the production of power. Heading the list will be the establishment of a twenty-million dollar research laboratory at Schenectady to be operated by the General Electric Company and devoted primarily to a study of power generation.

Other laboratories at Oak Ridge, Tenn., and at Chicago have been carrying on such research for some time, in addition to the work at Hanford; and, according to General Groves, the research and development facilities of a number of universities and industrial organizations are under contract with the Government for certain aspects of the problem. As previously announced, work has started on a pilot plant at Oak Ridge.

Although engineers played a most important part in providing the facilities for the manufacture of atomic bombs, it was the scientists who furnished the basic "know-how" for the release and control of nuclear energy. However, in its commercial application to power generation it will be the engineers and metallurgists who are most likely to play the major role.

It is inconceivable that these combined efforts of the Government, leading industrials and universities could fail to produce results, but, as has been pointed out many times by those best informed on the subject, economic considerations will determine the extent to which nuclear energy may eventually be utilized commercially for power generation.

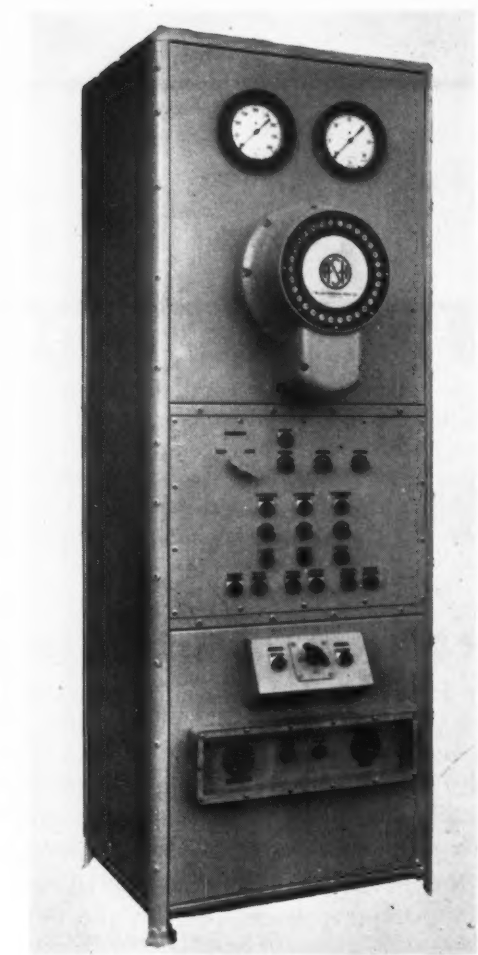
Recurrent Coal Disturbances

Once more John L. Lewis has precipitated a furor in the coal situation by his latest action in demanding that the contract between the Government and the United Mine Workers be reopened at this time. This action comes less than six months after the previous strike at which time, it will be recalled, the Administration surrendered to Mr. Lewis and granted, among other concessions, a $1.85 increase in the miners' daily pay and the five cents a ton royalty for a welfare fund. At this writing he has not publicly revealed the full extent of his new demands, but the immediate point at issue is his right to reopen the contract which specifically provides that it shall cover the period of Government possession of the mines.

Despite the fact that production has been satisfactory for several months past, the cumulative output of bituminous coal for the calendar year through October was some seven per cent below that for the corresponding period of 1945, and average stocks in the hands of consumers are over ten per cent less than on April 1 of the present year when the previous strike occurred. With the winter season approaching and electric energy demands at a new high, the country is ill prepared for another coal stoppage. It would appear that Mr. Lewis had well timed his new demands, also with a view toward securing them before the first of the year when the new Congress convenes.

The stiffening attitude of the Administration in its refusal to open the contract and its resort to court action to bar a strike, was perhaps as much of a surprise to Mr. Lewis as it was gratifying to many others. However, thousands of miners have already left their work without formal declaration of a strike and the Government has found it necessary to issue restrictive regulations on the use of coal. This means curtailed production in many lines at a time when it should be accelerated.

Things are moving too swiftly in the controversy to venture any prediction at this time as to the outcome, but it is believed that public opinion will be behind any action that will put an end to these recurrent disturbances in the country's coal supply at the dictation of a single individual.



Trends In Ash- and Dust-Handling Systems

By J. T. DEUTSCH
President, The Allen-Sherman-Hoff Co.

A review of some recent developments in the handling of dust and ash. Included are expansion joints that prevent air infiltration; linings of dry and submerged hoppers; mixing valves; and automatic discharge.

IT IS the purpose of this article to outline what the writer believes to have been the outstanding developments in modern ash- and dust-handling systems during the past few years. Even though we were all engaged in work for war plants and had very little or no time for experiment or change in fundamental design, there have been outstanding developments which were started previous to the war period and also some which, of necessity, had to be developed during the war. A few of these which have to do with the over-all design of modern ash- and dust-handling systems will be covered briefly.

Seal to Prevent Infiltration

Modern boiler design has developed to a point where it is quite essential that all air necessary for combustion shall be introduced at a certain place and at a certain time. Leaks in the setting where excess air can infiltrate are no longer tolerated. It became necessary, therefore, to develop an expansion joint between the setting walls, whether they be refractory or water walls, and the furnace bottom or ash hopper so that no air infiltration is possible. This has been accomplished by the seal shown in Fig. 1. It may be a water seal, a sand seal or some other material which will permit movement of the seal plate. Due to the fact that the four walls of a boiler setting may be at times on different elevations and each one expands both vertically and laterally a different amount, the development of the corners presented a problem which took a long time to solve. Very recently a major change was made in this design and has been found to be very satisfactory.

Modern furnace-bottom and ash-hopper design covers three types of construction. First, a completely dry bottom where no quenching water whatever is introduced, as shown in Fig. 2; second, a quenching hopper where water is sprayed continuously over the ash as shown in Fig. 3; and finally the submerged bottom which has in it a pool of water into which ash and slag are dropped and disintegrated as shown in Fig. 4. The linings for each of these three types are different not only in thickness but also in the materials used and the methods

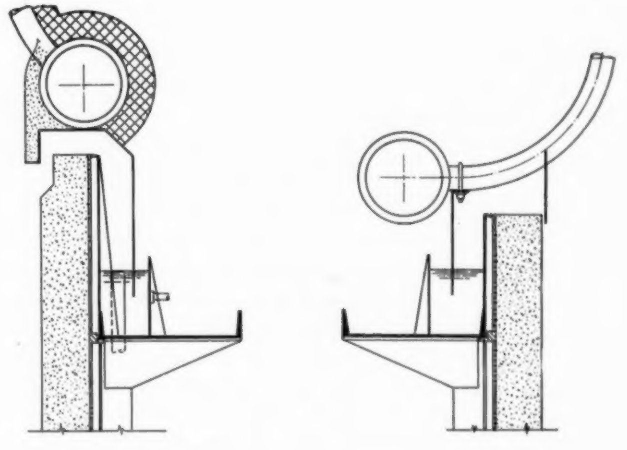


Fig. 1—Expansion joint between setting walls and ash hopper

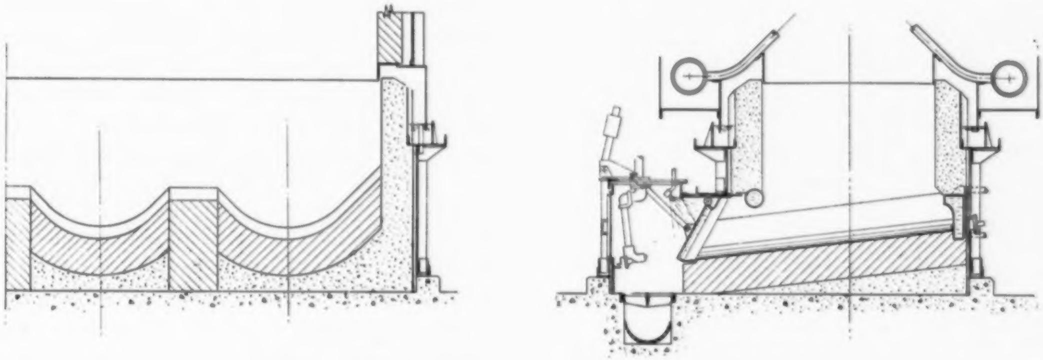


Fig. 2—Dry bottom without quenching water

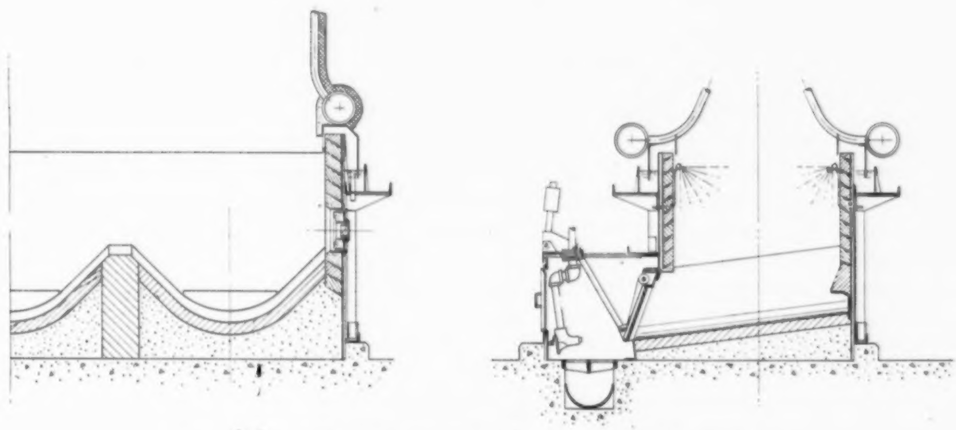


Fig. 3—Quenching hopper with water sprayed over ash

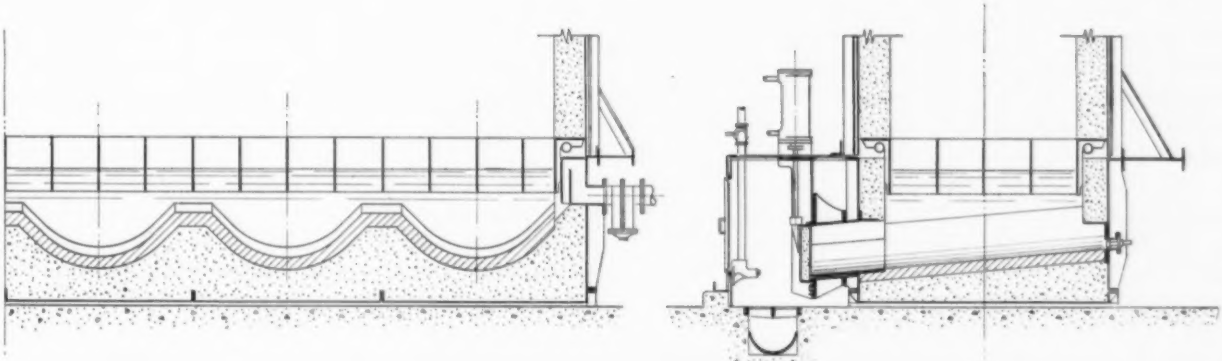


Fig. 4—Submerged type of bottom

used for applying them. In the first case, a monolithic lining of thickness dependent upon temperature and type of operation, with or without insulation as determined by conditions, is used. In the second case, depending upon temperature and slagging conditions, a refractory shape may be the indicated lining. In the case of the submerged hopper, the lining as might be expected deteriorates at the waterline due to thermal shock. For this type of hopper, a protection at the waterline is indicated and a method of cooling the protecting elements and keeping the water in the hopper itself quiescent so that continuous lapping along the sides cannot occur, has been found to be the most effective method.

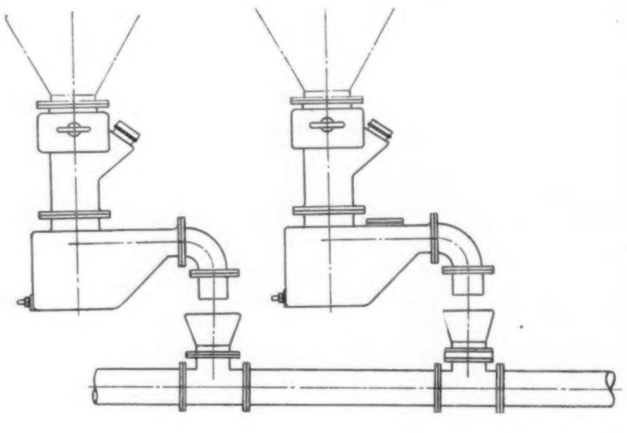


Fig. 5—Typical installation employing mixing valve

Probably the most important step, during the past ten years, in handling dust from hoppers beneath air preheaters, economizers and dust collectors has been the development of valves into which low-pressure water of given quantity is introduced and with which the dust mixes very thoroughly and is discharged continuously to a suitable fill site or to a sump, from which it is pumped to a point of disposal. With this system, the dust is continuously discharged into the valve and consequently no attendance is necessary and a very effective means of disposal results. Fig. 5 illustrates a section of a typical installation. The particular advantages of this system are:

1. No attendance necessary.
2. Negligible maintenance.
3. Necessity for relatively large storage hoppers beneath the apparatus is eliminated.

If a system of this type is applicable, any of the above savings pays for it in a very short time.

Where dust is handled in a dry state, an important development has been complete automatic systems controlled entirely by vacuum conditions. Each valve is opened and closed automatically and consequently there is no lost motion whatever. With nonautomatic systems there was always a question of whether an attendant has closed the valve tightly after having operated it or whether he forgot to empty one or two of the hoppers, or perhaps neglected to set pressure switches, atmospheric relief valves, etc. Any one of these omissions make for expensive operation. With the complete automatic system, the control mechanism automatically takes care of all of these things.

It is a fact that wear in dry-dust handling systems is attributable to the time the system operates rather than to the tonnage handled. Therefore, any system which definitely shuts off a dust hopper the instant it is empty and definitely cuts out the use of valves, pipe and fittings the instant the flow of dust stops is the one which in the long run will pay for itself over and over again.

It has been common practice when putting dry dust into a storage hopper to have above this main hopper a relatively small cyclone separator which is under vacuum while dust is being collected. This separator must be emptied every few minutes and when, as generally happens, a type of dump unloader gate is used, the vacuum must be broken and all material in the system at that time is dropped out of suspension. This sometimes causes plugging, particularly in vertical risers. Even though plugging does not occur, when the vacuum is renewed all the dust in the system must be picked up again. All of this means delay.

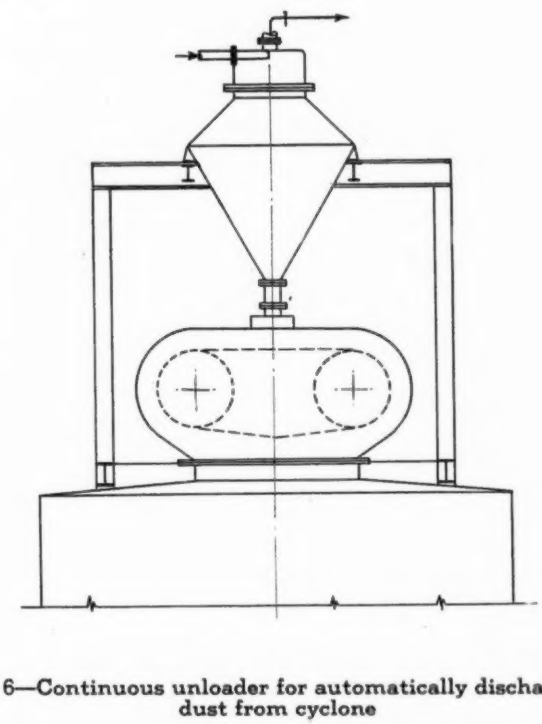


Fig. 6—Continuous unloader for automatically discharging dust from cyclone

A continuous unloader has been developed which automatically discharges the dust from the cyclone without breaking the vacuum. This is shown in Fig. 6. If it is considered that the system is down twenty-five per cent of the time due to the dumping period and perhaps loses five per cent more time picking up material dropped out of suspension when the vacuum was broken, the economy and savings in the use of a continuous unloader are easily pictured.

All of the above-mentioned developments are in use in power stations and have been thoroughly tested. Other developments just as revolutionary are being tested now and when they have proved their worth, will be described. Those described and those being tested now would not have been possible without the sympathetic help of many consultants, public utilities and manufacturing concerns.

*Progress in Transformation of Energy**

A. G. CHRISTIE
Professor of Mechanical Engineering,
The Johns Hopkins University

NO radical changes in basic methods for effecting transformations of energy have occurred in recent years. Yet many changes have occurred in the means employed to provide our present services. It has been the privilege of many of us in our lifetime to have observed changes in transformation machinery and methods. The first diesel engines at St. Louis Exposition in 1904 bore little resemblance to the diesel-electric units now used on locomotives. Majestic reciprocating engines like those in the 59th Street Station in New York, furnished with steam from batteries of small hand-fired boilers, have been superseded by high-speed, turbine-generators supplied from a single automatically controlled, pulverized fuel-fired boiler plant. Long distance transmission of electrical energy and other developments have made electricity available to almost all parts of this country and have contributed immeasurably to our national well-being.

Progress is evidenced by economic results. In 1920, the average coal consumption per kilowatt-hour was about 3 lb; today, the better central stations use 0.9 lb per kwhr. Domestic consumers in the United States in 1933 used an average of 600 kwhr per annum and paid 5.52 cents per kwhr. In 1945 this average consumption had increased to 1225 kwhr costing 3.42 cents per kwhr. Electrical energy is the outstanding commodity that has steadily decreased in price in spite of booms, depressions, wars, higher fuel costs and greatly increased wages for labor.

Economic Factors

Certain factors have contributed to this economic progress in energy transformation. Our sources of energy are either falling water or fuels. Hydroelectric plants constitute about 30 per cent of this country's generating capacity for utility services and produce about one-third of the total kilowatt-hours. Small low-efficiency water wheels have been superseded by large units with efficiencies that will be increased but little by further improvements. Most hydroelectric sites capable of development at low cost, have already been utilized. Increasing fuel and labor costs in other generating stations will justify the development of additional hydro sites heretofore considered marginal. The seasonal flow of rivers has necessitated the connection of hydroelectric plants to systems having large steam stations. The need for storage at headwaters has been recognized and further steps in providing storage should be taken as rapidly as possible to increase the firm power capacity of hydro plants and thus lessen the expense of standby steam plants. Improvements in long-distance transmission will lead to the development of sites at locations heretofore considered too distant.

The improvements in internal-combustion engines during the present century have been phenomenal. The total horsepower capacity of such engines in this country exceeds that of other means of power generation. Such engines in automobiles, tractors, trucks, locomotives, airplanes, etc., are operated by all classes of people and have greatly lessened the labor of farmers and domestic animals. Diesel-electric units will probably be used more extensively in locomotive service and to replace electric traction in cities. Isolated communities also get power from diesel sets. While diesel engines have high efficiencies which may be increased only slightly, much improvement in the thermal efficiency of the widely used gasoline engine is still possible. High octane fuels encourage engineers to make these improvements.

Performance of Modern Stations

Remarkable progress has been made in the development of electrical energy in steam plants. Carnot in his "Reflections on the Motive Power of Heat," cited the best known performance of steam engines in his time as that of English units with an overall thermal efficiency of 5 per cent. While some of our present-day locomotives give results little better than this figure, many central stations operate at thermal efficiencies of about 28 per cent. Stations with high pressures and temperatures exceed this performance with the best record to date in the neighborhood of 31.7 per cent.

To cope with increased fuel costs, plant efficiencies have been improved by increasing both pressures and temperatures of the steam. In Carnot's time 100 psi was regarded as high pressure. A power plant is in operation in the U. S., with a pressure of 2300 psi. Many engineers hold that for present system conditions steam pressures of 850 psi and 900 F total temperature leads to the most economical operating plant. This can be only a temporary situation for improved alloys for superheaters, piping, etc., will allow increased steam temperatures and this, in turn, permits the steam pressure to be raised above present practice. Increasing fuel prices will force the use of increased pressures and temperatures.

High wages were an important element in forcing the development of large steam generators and their auxiliaries. These steam plants are now generally automatically controlled with instruments to indicate performance results. Brains have superseded brawn as a characteristic of operators of modern steam stations.

Present plants generally operate on the regenerative cycle where a portion of the working steam is withdrawn in steps from the turbine and used to preheat feedwater. Increased initial pressures and temperatures will lead to the employment of more stages of extraction and better station performance. The lower end of the cycle is fixed by available cooling water and further gains there are

* From an address at the Princeton Bicentennial Conference, Princeton, N. J., October 2, 1946.

thus limited. J. F. Fields, in England, has suggested some changes in this cycle that might lead to higher efficiency. Outside of the possibilities noted above, there do not appear to be any radical developments of the steam cycle pending at the moment.

Cycles employing other working substances than steam have been investigated. Of these the binary mercury-steam cycle is most promising and has been in commercial use in several plants. While higher efficiencies than on the regular steam cycle are possible with mercury-steam, its commercial adoption up to the present, has been delayed by high costs of plant and by development troubles with the mercury-vapor generator. The latter are being overcome by experience. Rising fuel costs place this cycle in a more favorable position and one may expect its increased use in the future.

Industrial power plants have followed the trends of central station development. Higher fuel and labor costs have led to better designed plants using increased steam pressures and temperatures. Many industry plants generate power as a by-product since the principal purpose of the plant is to provide steam at required pressures to industry. Such power is generated at a low figure represented by increment fuel and labor costs and by fixed and maintenance costs on the electrical plant. The application of power generation in connection with central heating systems in northern communities is a future possibility. However, the economics of such installations is affected by seasonal variations and by the probability of uneconomic plant operation during the off-peak heating season.

A recent development arousing much interest is the gas turbine. From an operating point of view it has many favorable features. Although in the first stages of development and still made only for comparatively small outputs, efficiencies have been obtained that compare favorably with the better central stations. A major problem has been the production of new alloys which will withstand high temperatures and still retain good strength. When such metals are available and initial temperatures are increased, the gas turbine could show higher efficiencies than average central stations. Progress in the development of a coal-fired gas turbine has been most encouraging. The closed-cycle type of turbine can be built for large outputs. The present high initial costs may be reduced with increased use. This type of prime move warrants consideration in the future.

Many have speculated on the possibilities of atomic energy as a source of power. While large amounts of heat and other energy are released by the so-called atomic action, losses occur in converting such heat into electric energy by presently known methods. Also considerable power is expended in preparing materials for atomic reaction. Until more data are released on these requirements, engineers cannot fairly appraise the possibilities of atomic power for commercial purposes.

As earlier noted, our present sources of energy are falling water and fuels. While substantial progress has been made, even our best plants recover in electrical energy less than one-third of the heat value of the fuel. There still remains much opportunity to develop further improvements in thermal efficiency.

Joint Fuels Meeting Discusses Anthracite Burning and Coal Sizes

THE Ninth Joint Meeting of the Coal Division of the American Institute of Mining and Metallurgical Engineers and the Fuels Division of the American Society of Mechanical Engineers was held at the Bellevue-Stratford Hotel, Philadelphia, October 24–25. The morning sessions of both days were given to papers on mining subjects, whereas the afternoon session on Thursday dealt with anthracite utilization, and on Friday afternoon a Panel Discussion sought the answer to "Why so many sizes of coal?" Only those papers of concern to power engineers are here reported.

Burning Anthracite in Glass Tubes

R. C. Johnson, vice president of Anthracite Institute, described and showed colored motion pictures of the combustion of anthracite in glass tubes, the investigation being related to development work in domestic heating. Glass cylinders of various diameters up to 8 or 9 in. were employed, depending upon the size of coal burned, and under drafts of $^1/_2$ in. to 4 in. high rates of burning were attained. The cylinders had double walls between which circulated deaerated water. By speeding up the film the progress of ignition and ash formation was plainly evident, and in all cases a white vapor formed above the incandescent fuel and deposited on the coal and glass above it. Analysis of this deposit showed it to contain silica and alumina. The temperature of the products of combustion leaving the top of the cylinder was relatively low, in the neighborhood of 250 F, thus indicating high efficiency of heat transfer to the water.

Burning Anthracite on Traveling Grates

The second paper, by **C. S. Gladden,** presented test data on the quantities and characteristics of cinders and fly ash when burning small sizes of anthracite on traveling-grate stokers; also the precipitation of cinders and fly ash at various collection points, the influence of fines on the quantity produced, and a description of an efficient method of recirculation and reburning.

The plant at which these tests were conducted was the Cherokee Ordnance Works which was operated during the last 18 months of the war by the Heyden Chemical Corporation, of which the author was then chief engineer.

About 80 per cent of the coal burned was from river dredging operations, the remainder being small-sized freshly mined anthracite, and the total ash averaged about 18 per cent, of which approximately 10 per cent was inherent. The general arrangement of the 110,000-lb per hr steam-generating unit upon which the tests were made is shown in the accompanying sketch, Fig. 1, on which the cinder traps and points of cinder measurement are indicated. It will be noted that revolving-type cinder traps are located at *A* and *B* below the boiler cinder hoppers; also there is another trap at *D* at the base of the stack. At *F* a 6-in. pipe connection from the forced-draft duct supplies heated air to each of the cinder delivery pipes passing through the rear arch. Since a suction pressure of 0.75 to 1 in. existed at *A* and *B* but none at *D*, it was decided to connect the stack cinder hopper directly with *B* as indicated by the broken line, so that there would be a continual recirculation of the cinders from *D* to *B*.

This system performed very well, and no evidence of need for maintenance was indicated within the first year

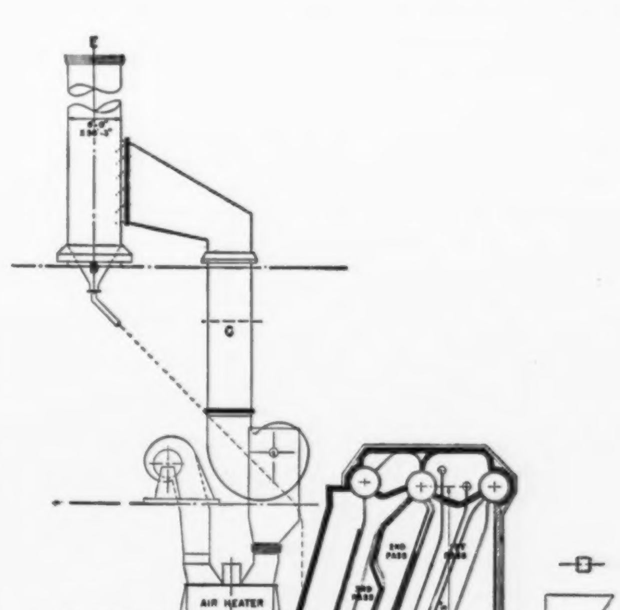


Fig. 1—General arrangement of steam generating unit showing points of trapping cinders and fly ash

of operation. However, despite reversal of the downward flow between the second and third boiler passes which precipitated cinders at *A* and that taking place above hopper *B*, there were sufficient cinders and fly ash remaining in the stack discharge to warrant investigation of its economic value. Hence, "cinder quantity tests" and "cinder-recirculation tests" were undertaken. During the

former, none of the cinders and fly ash were returned to the furnace, for reburning, but were collected. Simultaneous measurements were also made at *C* in the discharge from the induced-draft fan. From the large amount of data collected, the following average relative quantities and fineness of cinders at the various locations were shown:

	Total Cinders and Fly Ash, %	Average Fineness Through 50 Mesh, %	Through 100 Mesh, %	Through 200 Mesh, %
Cinders between 2nd and 3rd passes	77	16.2	2.1	0.5
Cinders between 3rd pass and air heater	8	57.2	12.7	2.9
Cinders at base of stack	3	79.6	28.1	6.8
Fly ash to atmosphere	12	95.9	70.7	40.4

From this it will be seen that the cinders at each location become coarser as the combustion rate increases, and the percentages of the finer material increase progressively as the cinder-collecting hoppers approach the stack.

A series of four recirculation tests were conducted to determine the amount and characteristics of the fly ash discharged from the stack under normal conditions. With correction in the data to include recirculation of the stack cinders, the total pounds of fly ash discharged per hour, the per cent of carbon in the fly ash, and the total ash for different combustion rates are plotted in Fig. 2, whereas Fig. 3 shows the carbon loss to atmosphere.

It would appear that the economic loss of the carbon accompanying ash becomes excessive when the combustion rate exceeds 25 lb per sq ft of grate per hour. This indicates the desirability of installing a fly-ash collector between the boiler outlet and the inlet to the air preheater, and returning the cinders and fly ash thus collected to the furnace for reburning.

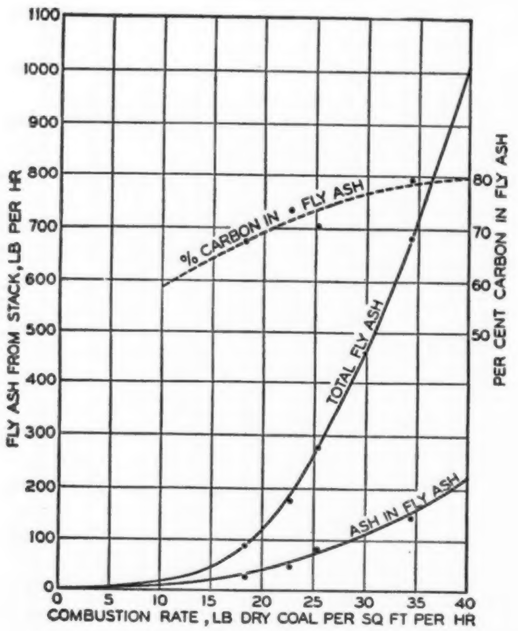


Fig. 2—Fly ash to atmosphere at different combustion rates

Discussion

In discussing Mr. Gladden's paper, **John Van Brunt,** vice president of Combustion Engineering Company, mentioned the first installation for cinder recovery as having been made at the Naticoke plant of the Glen Alden Coal Company about 25 years ago. Here a portable motor-driven blower was connected to the third boiler pass hopper and the dust from the hopper was blown over the rear of the stokers. By thus moving the blower from boiler to boiler, the cinders were intermittently fired during which time the output of the boiler would increase 20 to 25 per cent for periods of 10 to 20 minutes. Recent practice, of course, dictates that the cinder should be returned to the boiler continuously.

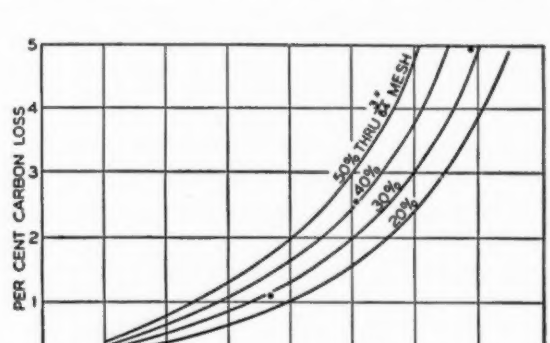


Fig. 3—Carbon loss to atmosphere

At a constant combustion rate cinder carryover appears to be directly proportional to the undersize, that is, fines which pass through a $^{3}/_{64}$-in. screen.

Mr. Van Brunt referred to recent heat-balance tests on a 200,000-lb per hr unit at the new Jennison Station where No. 4 buckwheat was burned on a C-E traveling-grate stoker with overall efficiencies of 84.7, 87.6, 86.3, and 85.3 at outputs of 153,000, 208,000, 107,000 and 126,000 lb of steam per hour, respectively. The corresponding combustion rates were 24, 31, 16.4 and 19.2 lb per sq ft of grate per hour and the cinder losses 3.8, 2.88, 3.2 and 4.32 per cent. Of these approximately one-third are ash-pit losses and the balance due to cinder passing through the dust collector.

At the Cedar Street Station of the Pennsylvania Power & Light Company a similar installation burning fine anthracite is operating at an efficiency of 83 per cent by the month. These efficiencies would not be possible without the installation of a dust collector and reburning of the collected material.

C. H. Bean referred to experience with a 200,000 lb per hr boiler at the Bound Brook plant of Calco Chemical Company. Fine sizes of anthracite are burned on a traveling-grate stoker at 30 to 35 lb per sq ft of grate per hour and the collected cinders and dust are reintroduced into the furnace by means of steam jets. Operating experience over $4^{1}/_{2}$ yr has been most satisfactory and there has been no perceptible wear on the induced-draft fan.

Grinding of Anthracite for Pulverized Fuel

C. H. Frick, of the Pennsylvania Power and Light Company, presented a paper reviewing the experience of that company in the pulverizing of anthracite at the Lykens, Pine Grove and Hauto installations. No. 5 buckwheat, passing through a $^{3}/_{64}$-in. screen is employed.

The first installation to burn anthracite in pulverized form was at the Lytle power plant of the Susquehanna Collieries in 1918; but this was on a very small scale. In 1921 the same company placed in service a second and

larger installation at its Lykens Plant which subsequently in 1942 was taken over by the Pennsylvania Power and Light Company. Here the anthracite, which contained about 8 per cent volatile, was dried and ground to a fineness of about 82 per cent through a 200-mesh screen.

This was followed by use of pulverized anthracite in the extension to the power company's Pine Grove Plant where three 70-in. screen-type vertical mills were initially installed; but these were later replaced by ball-and-tube mills.

For the extension to Hauto Station, placed in service in 1943, pulverized anthracite was employed to fire the two large high-pressure boilers. The preparation plant, which supplies a storage system, consists of two cylindrical rotating driers, each 60 ft long by $7^1/_2$ ft diameter, of 30 tons per hour capacity from 20 per cent initial moisture to 1 per cent final moisture, and three horizontal ball-and-tube mills, grinding to a fineness of 85 per cent through a 200-mesh screen. The driers are heated by separate stoker-fired furnaces.

Experience has shown that to maintain maximum output at desired fineness, the coal feed to the mill should be as uniform as possible and the coal in the mill main-

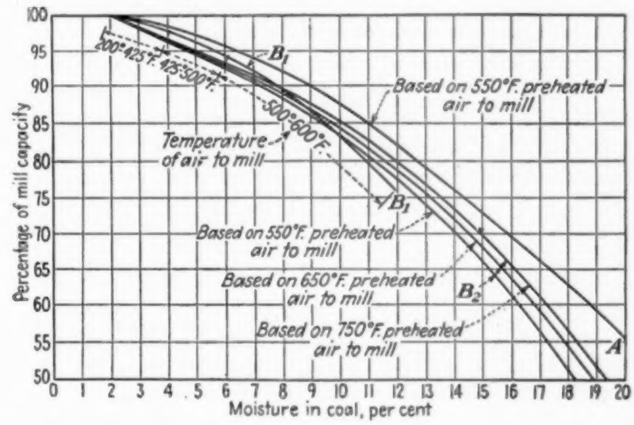


Fig. 4—Effect of moisture on capacity of horizontal ball-and-tube-mill

tained at the best predetermined level. The coal feed can be regulated by using an electric eye working in conjunction with a draft connection at normal coal level in the mill. A cyclone should be in the circuit ahead of the mill exhauster to remove the finished product and reduce exhauster maintenance, as well as a separator ahead of the exhauster to remove coarse particles. There is an optimum speed of a mill of given diameter for maintaining maximum output and desired fineness. This must be determined for the individual installation.

Anthracite does not behave like bituminous coal, which is ground in a vertical mill, in that the coefficient of friction between the various anthracite particles is very low and they have a tendency to slide on each other and off the ball race; whereas with the horizontal mill, many tons of small balls are raised by rotation of the mill and in dropping produce innumerable hammer blows which crush the coal.

Output of a given fineness varies with the initial moisture of the coal entering the mill if external drying is employed, but where mill drying is used it is customary to employ air preheated to 500 or 550 F. The capacity of the horizontal ball-and-tube mill drops considerably with an increase in entering moisture, as is indicated by the curves in Fig. 4.

At Pine Grove, experience over $6^1/_2$ yr showed the loss in weight of forged-steel balls to be 0.67 lb per ton of coal ground, whereas a year's run with Ni-hard balls (4.5 per cent nickel, $1^1/_2$ per cent chromium) showed a loss of weight of 0.31 lb per net ton of coal ground. At Hauto, where more than 250,000 tons of anthracite is ground per year, the saving in annual expense of ball replacement is estimated to be at least $5200 through use of Ni-hard balls. A test is now under way with copper-molybdenum steel balls.

For the three years during which vertical mills were used at Pine Grove, and a wide variation in type of fuel was used, the maintenance cost (labor and parts) was 41 cents per ton ground; whereas with the horizontal ball-and-tube mill the comparable cost was 8 cents per ton over an 11-yr period. The larger units at Hauto show a like maintenance cost of 8 cents per ton over a 2-yr period.

The total operating and maintenance cost of preparing and pulverizing the small-sized anthracite at Pine Grove has averaged 36 cents per ton over an 11-yr period, and at Hauto the total cost has been 42 cents per ton over a 2-yr period. These figures include maintenance, labor and materials, but exclude the cost of electric energy. This energy averaged 34.5 kwhr per ton at Pine Grove and 36.5 kwhr per ton at Hauto for motors driving the drying, grinding and conveying equipment.

The new Sunbury Plant of the Pennsylvania Power and Light Company, now under construction, will depend on mill drying of anthracite, but for constant flow of coal to the boilers when the anthracite is very wet some bituminous coal will be added.

Why So Many Sizes of Coal

The Panel selected to discuss this subject was made up of representatives of coal producers, stoker manufacturers, research, retail dealers and consumers, with **E. C. Payne** of Consolidation Coal Company as leader of the Panel.

Speaking for Middle West Districts 9, 10 and 11, **Howard Herder,** of Sahara Coal Company, Chicago, stated that these districts, combined, accounted for the annual production of around 120 million tons comprising about 100 different sizes, ranging from $^1/_{16}$ in. to 8 in. and employing some 19 different screens. However, the sizes were not so diverse when considering individual mines. The great number of sizes he attributed to various factors such as flexibility in the preparation plants, impurities in coal seams requiring crushing down for removal, mechanical mining methods, competition between mines, price, demands of fuel-burning equipment, special purpose uses, and supply and demand. He was of the opinion that small differences in size made very little, if any, difference in burning; and that probably six different sizes with proper size pricing would suffice to meet practically all requirements.

Mr. Mabley, speaking for District 8, the largest single district in the country, was of the opinion that there was good reason for many sizes. These reasons he listed as the many uses for coal, the highly individual efforts of equipment manufacturers and the resulting variety in designs of fuel-burning equipment, competition among producers, a wide variation in the characteristics

of coals from different seams, overloading of boiler plants, consumer preference, and competition between salesmen. He believed, however, that of late many of the manufacturers of fuel-burning equipment have done much to standardize, and as more boiler plants are modernized, the demand for so many coal sizes should decrease.

A. W. Thorson, speaking as a representative of a large stoker manufacturer, confined his remarks to sizes of 2 in. and under from Districts 1–12, constituting about 100 million tons annually. Based on 1937 prewar figures, selected as normal, 75 per cent of this production was in four sizes. For burning on chain- and traveling-grate stokers, he cited $1^1/_2$ in. $\times$ zero, $1^1/_4$ in. $\times$ 0, $^3/_4$ in. $\times$ 0 and 1 in. $\times$ 0; for spreader stokers $1^1/_2$ in. $\times$ 0, $1^1/_4$ in. $\times$ 0, and $^3/_4$ in. $\times$ 0; for multiple-retort underfeed stokers 2 in. $\times$ 0 and $1^1/_4$ in. $\times$ 0; and for single-retort underfeed stokers $1^1/_2$ in. $\times$ 0 and $1^1/_4$ in. $\times$ 0. Sizes for anthracite are, of course, standardized. While suggesting that $1^1/_4$ in. $\times$ 0 for stokers and $^3/_4$ in. $\times$ 0 for pulverizers might be recommended, Mr. Thorson conceded that there are other factors that might make certain tolerances necessary. However, a large proportion of the shipments now fall within these two sizes.

Mr. Coryell discussed the coal requirements of small domestic and industrial stokers that employ screw feed. With such a stoker silence in feeding determines the top size to be used. Other factors are burning characteristics, penetration of air, cleanliness, segregation and price.

C. S. Sheaffer, speaking for the retailer and small consumer, recalled that much dissatisfaction has resulted from inability of consumers to procure the desired coal sizes during the past few years. He believed it possible to greatly simplify the sizing and still meet requirements for handling, burning performance and customer acceptance. He suggested that now is the time to undertake standardization in sizing because customers have been accustomed to not getting the size desired.

A. A. Raymond, speaking of railroad requirements, cited the high cinder loss from locomotives which makes double screening desirable. Much of this loss is incurred during periods of acceleration which, as an example, between Harmon and Buffalo represent 64 per cent. Burning rates as high as 150 to 190 lb per sq ft per hr are encountered during acceleration. The most desirable size for locomotive fuel he believed to be $2^1/_2 \times 1$ in. egg.

3½ Million Kilowatts of G-E Turbine-Generators on Order

The nation's electric power generating capacity will be increased by more than 3,500,000 kilowatts within the next two years when installation of steam turbine generators to be built by General Electric in that period is completed.

This new equipment will raise the capacity of steam turbine electric generating plants operated by electric light and power companies in the U. S. to over 37,000,000 kw, a new high. An additional output of nearly 15,000,000 kw of electric power is produced by hydroelectric stations.

According to C. S. Coggeshall, manager of the G-E Turbine Division, the turbine-generators which will make up the $3^1/_2$ million kilowatts of power range in output from 10,000 to 150,000 kw. "A recent market analysis," he said, "indicated that steam turbines producing 14,000,000 kw should be installed within the next three to four years. Seventy-two per cent of the operating companies of the country were reached by this survey, and the results were later confirmed by two other sources working independently.

"The tremendous buying at the present time is expected to continue after 1950, barring any national economic upset. Factors influencing this continued purchase of power-producing equipment include not only the huge prospective buying of electric appliances, the construction of new homes, and the greater use of electricity in industry, but also the need, after 1950, of replacements for obsolete turbine-generator units."

Many Old Turbines in Service

The average age of turbines being replaced today is approximately 31 years. However, the installed capacity curve did not rise sharply until 1915, indicating a larger percentage of steam-turbine-generators will reach the retirement age at mid-century.

Mr. Coggeshall also stated that over 95 per cent of the turbine-generator orders on the company's books are for domestic users, and that the apparatus is going to customers in 31 of the 48 states. New York leads with a total of six units to be installed with a total capacity of 265,000 kw, closely followed by New Jersey, Illinois, Ohio and Pennsylvania.

Three out of four of the units on order will be hydrogen-cooled. Rotative speed of 3600 rpm seems to be the most popular as nearly 89 per cent of the units are thus rated, with the remainder in the 1800-rpm category. Steam inlet conditions range from a low of 185 psi at 500 F to a high of 2000 psi at 1050 F, with 72 per cent of the turbines operating at inlet steam temperatures 900 F or above.

In addition to the $3^1/_2$ million kilowatts on order for utilities, the company also has a total of 65,000 kw slated for various industrial plants in the United States.

No figures appear to be available as to the aggregate turbine capacity now on order from all builders. But recalling that there are two other American builders of large central-station units, in addition to a number of others that build smaller machines chiefly for industrial plants, some idea of the present activity in the field may be gained from the above report of one company alone.

Modern Design and Operation of Soot Blowers

During the past few years soot blowing of power boilers has undergone extensive development, including new types of blowers, automatic operation, remote control and the introduction of compressed air as a blowing medium. Such development and the application of different types were reviewed in two talks before the Metropolitan Section A.S.M.E. on October 23, one by W. J. Fitzburgh, assistant to the president of Diamond Power Specialty Corporation, and the other by D. E. Hibner, Jr., vice president and chief engineer of Vulcan Soot Blower Corporation. The high spots of these talks are here given.

MR. FITZBURGH, the first speaker, recalled that less than ten years ago boilers were equipped throughout with fixed-position rotary soot blowers in which the blower element nozzles had to be maintained in register with the tube lanes to prevent tube erosion. In contrast with this, present practice often locates the elements 10 to 30 in. away from the tube banks, employs large nozzles discharging high mass flow, does not attempt to maintain nozzle registry, and arranges the elements to blow in the direction of the gas flow. Tube erosion has been materially reduced by avoiding blowing against the direction of gas flow (particularly downward) and wherever possible into corners or against hangers and supports where ash has accumulated.

Use of retractable soot blower units is rapidly increasing. Although originally intended to handle severe slagging conditions in locations where gas temperatures exceeded the limit for fixed rotary blowers, the present tendency is to use them even in the cooler locations, because a large amount of energy can be discharged over a small section of heating surface without fear of tube erosion. Also, since these blowers are outside the boiler setting when not in use, practically no maintenance is required.

As to types and designs applicable to various locations, Mr. Fitzburgh described, the fixed-position automatic-valved steam rotary blower, driven by an air motor; the air-puff blower and its master controller; the short retractable blower, having a poppet valve to prevent steam leakage and flow until the nozzle is in blowing position, and suitable for either wall or screen cleaning by changing the nozzle; the long retractable type, with either air or electric motor drive, which is in effect a power-driven lance; the telescopic blower which is used where clearance outside the boiler is insufficient to permit use of the long retractable type; the straight-line blower for air heaters of both the simple design and the air-puff type; and the automatic blower control panel.

Air-Puff Blowers for Port Washington

Slides of numerous installations of various types were shown, particularly the blowers now being installed for the third unit at Port Washington Station, Milwaukee. Here, air-puff soot blowers will be employed for the convection banks of the boiler and telescopic blowers will serve the convection superheater and boiler screen. The furnace walls, slag screen and radiant reheater will be cleaned by automatic air-operated short retractable blowers using steam. The automatic air-blowing installations now operating at Huntley and Oswego Stations were also described.

The speaker then presented a tabulation comparing the relative merits of automatic steam, automatic air and air-puff blowing. In this connection, he observed that the cost of automatic air blowers, exclusive of the compressor-receiver station, is approximately the same as the cost of automatic steam blowers; and the additional investment for the compressor-receiver station must be offset by the larger saving in energy by use of air and certain other factors.

Combination of Air and Steam Blowers

Retracting blowers during operation must have the blowing medium flowing continuously to prevent failure due to high gas temperatures. Long retracting blowers using small flow demand for long periods and short retracting blowers using large flow demand for short periods necessitate high-pressure compressors to avoid use of large costly receivers. However, where advisable, the initial compressor-receiver station investment can be lowered appreciably by using steam blowing on the retracting blowers and air blowing on the units located permanently inside the settings. Thus the benefits common to both automatic systems and the partial benefits of an all air-blowing system can be obtained. The two most important improvements toward the economical use of air were adoption of the air-puff design and development of special low-pressure drop heads.

Reference was made to the operating savings reported for automatic air-puff soot blowers at the Huntley and Oswego stations in a paper by H. L. Smith at the A.S.M.E. Semi-Annual Meeting last June.[1]

In conclusion, Mr. Fitzburgh answered the question, "How can air take less fuel from the coal pile than steam?" by saying that the greater density of air over steam, at the same pressure, results in higher air energy at the point the blowing medium is put to work even though there is less energy in the air to begin with.

Second Paper

MR. HIBNER described the functioning of various Vulcan soot blowers and their respective application to different locations in a steam-generating unit.

For furnace walls a retractable deslagger is used. This employs an air-operated piston to extend and retract the blowing element which is rotated by an air motor. The blowing medium may be steam or air, although the former is more frequently used for deslagging the walls of large high-pressure boilers because a sufficient quantity of steam at any desired pressure is always available, whereas with air the pressure and quantity are limited by the compressor and receivers.

A similar unit, except for nozzle design, is the gun-type mass blower employed for cleaning slag-screen tubes, certain wall tubes and furnace floors. These may be installed in the furnace walls or roof.

For slag screens and superheaters Mr. Hibner recommended the Model T-2 long retractable unit, operated by air motors. This is applicable to high temperature zones up to 2200 F in place of hand lancing, and the cleaning range is more than double that obtained with the multi-jet rotary type of unit.

Since the retractable units generally operate in high-temperature zones, continuous blowing is necessary when the nozzles are extended into the furnace, as the blowing medium cools the element and nozzles and maintains their life. Actual blowing time for the Model T-2 unit depends on the furnace width and continuous blowing will be necessary from 4 to 10 minutes.

For tubular air heaters a traveling-frame soot blower, having a three-cylinder air motor, is used. The traveling frame carries one or more blowing elements with nozzles spaced to blow directly into each air heater tube as the unit travels. The same type is also used for cleaning horizontal economizer tubes, and can be built to operate continuously or intermittently throughout the blowing arc.

The above-mentioned units are designed to use either steam or air as the blowing medium. However, for the average boiler where initial cost is important, Mr. Hibner believed steam to be more economical. Nevertheless, each job must be decided upon its individual merits. For installations where deslagging blowers are necessary and where compressed air is desirable for cleaning the low-temperature zones, a dual blowing system using high-pressure steam for wall blowers and retractable units, and compressed air for cleaning the low-temperature zones may prove the most practical and economical.

[1] For abstract of this paper see COMBUSTION, July 1946.

All of these units are designed to operate with individual push-button remote control or automatic sequential control. With the former it is necessary for the operator to start each unit by the hand push-button, whereas with the latter the units are operated by a drum controller on the panel.

Operating data at present available covering automatic sequential steam blowing systems indicate that the steam consumption will vary, for different types of boilers and different operating conditions, from one-tenth to one-half of one per cent of the total steam generated by the boiler. With manually operated steam blowers the steam consumption is generally much higher and is estimated at one to one and a half per cent of the steam generated.

A true comparison between automatic steam and automatic air blowing would require two identical boilers in the same plant operating under the same conditions, one equipped for steam and the other for air. While cost figures obtained from certain automatic installations seem to favor steam, air blowing has many advantages that cannot be readily evaluated but which over a period of years may offset the higher maintenance of a high-pressure steam blowing system.

Water Conference Postponed

Because of the hotel strike in Pittsburgh, the Seventh Annual Water Conference, sponsored by the Engineers' Society of Western Pennsylvania, originally scheduled for October 28–30, has been postponed to December 2–5.

This year's program comprises some seventeen or eighteen formal papers, each followed by a number of prepared discussions presented by authorities in the particular branches of the fields covered, and then by general discussion. The topics divide broadly into those dealing with power plant practice and those dealing with industrial waters. Among the former are listed papers on "German Power Plant Water Conditioning Systems," by W. W. Cerna; "An Endpoint Indicator for Determining Dissolved Oxygen in Boiler Feedwater," by Dr. R. C. Ulmer; "Improvements in Steam Quality," by A. L. Jacoby; "Identification of Types of Carry-over," by P. B. Place; "Silica Deposits in Steam Turbines Resulting from Softening of Makeup through Natural Zeolite," by F. R. Owens; "Removal of Silica from Turbine Blades," by D. Forty; "Effects of Gases in Water," by T. E. Larson, and a Symposium on "Silica Removal by Ion Exchange" upon which there will be four papers, followed by the prepared discussions.

International Standards Body Formed

A new international organization for standardization has just been formed by delegates from 25 nations meeting in London.

It is expected to be known as "ISO" and headquarters will be set up in Geneva, Switzerland. The new organization consolidates the work of the old International Federation of National Standardizing Associations (ISA) and that of the war-born United Nations Standards Coordinating Committee. The International Electrotechnical Commission, a third important standardization agency, is expected to affiliate with the ISO as its electrical division.

Howard Coonley, chairman of the executive committee of the American Standards Association, has been chosen president of the new organization, and Gustave Gerard, president of the Belgian Standards Association will be vice president.

PRES. YARNALL DISCUSSES ECONOMIC STATUS OF ENGINEERS

PLACING better industrial relations high on the list of responsibilities that must be shouldered by the engineering societies, D. Robert Yarnall, president of the American Society of Mechanical Engineers, declared before its Metropolitan Section on November 8, that a sense of direction is expected by its younger members. "They want some organization to turn to now and if I understand them correctly," he said, "they do not want the union kind, although unions are now doubling their efforts to organize engineers."

Stating his concept of the engineering profession as based on truth and integrity, intelligence of the individual, and responsibility alike to consumers, owners and the public, Mr. Yarnall observed further that engineers in the middle-age and older groups are very largely executives, managers or chief engineers, and in most cases are responsible for the selection of younger engineers whom they look upon as the potential from which the next generation of managers and executives may come.

Management's Responsibility

"It is true," said Mr. Yarnall, "that the best men have high scarcity value; hence they can best bargain individually. Men of average or less than average ability certainly have less power in individual bargaining, but does it necessarily follow that their best course for advancement would come through unionism and collective bargaining? This is where good management should provide an adequate personnel policy which will not lose touch with the best man, the average man, or the sub-average man in his needs and right for advancement.

"How can we better develop a professional spirit in engineering than by driving home over and over again the conviction that management must assume more responsibility for encouragement, recognition and advancement (when earned) of all technical men. The potential professional serving his internship in a sub-professional group as a union member in a large company may gain useful experience, but let him beware of the limitations of a system designed for the average engineer. Engineers should carefully weigh these values when confronted with decisions concerning collective action."

E. J. C. Surveys

The speaker then told of the surveys now being conducted by the Engineers Joint Council, representing five of the leading engineering societies. These deal with the economic status of the engineer and include:

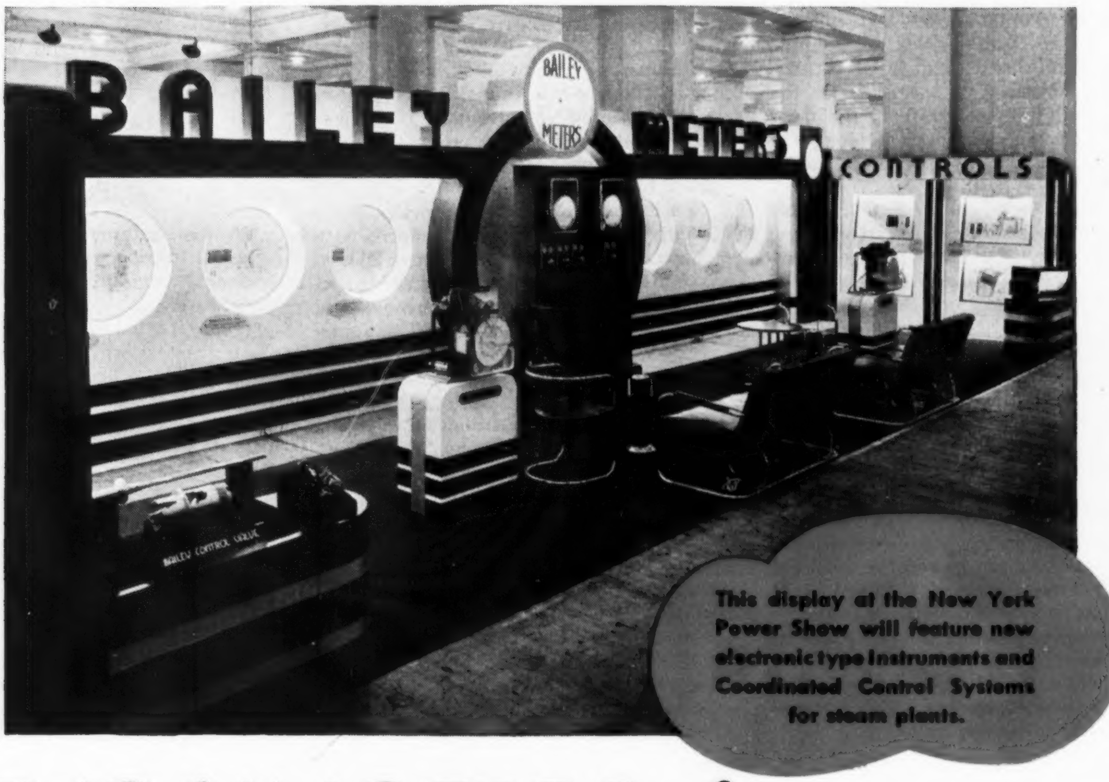
1. A survey of reports of earnings of 85,000 engineers with relation to education, years of practice and field of specialization. This report will be completed in June of 1947.
2. A survey of 2000 industrial companies with reference to company policies pertaining to selection, training, placement, advancement, guidance and professional activities of graduate engineer employees.
3. A survey of the problem of collective bargaining as it affects or may affect engineers in professional work and in training.

The results of the first two surveys will be made widely available and the third, in the form of a manual for the guidance of engineers is nearly completed, the type having been set. It will be available shortly.

Another course of action, Mr. Yarnall said, is suggested by the recent formation of the National Professional Employees Association, composed of engineers, architects, industrial scientists and similar professional employees. Their purpose is defined as "to promote the welfare and professional status of members and the right of professional employees to bargain collectively through agencies of their own choosing." They plan to assist groups to set up bargaining units independent of the national unions.

In conclusion, Mr. Yarnall said:

"A plan of procedure has been made which suggests that the time has arrived when the founder engineering societies must take positive and immediate action to combat the expansion of labor unions into the engineering field. This point of view would encourage all members to obtain their professional licenses through their state section of the National Society of Professional Engineers. It is claimed that such positive action by the founder societies would enable the professional engineers to present a united front against the threat of unionization and in defense of their hard-earned status as professional men.


BAILEY
BAILEY METERS
METERS
CONTROLS
This display at the New York Power Show will feature new electronic type Instruments and Coordinated Control Systems for steam plants.

A.S.M.E. ANNUAL MEETING PROGRAM

THE program for the Annual Meeting of the American Society of Mechanical Engineers, to be held at the Hotel Pennsylvania, New York, December 2-6, contains some 150 papers and addresses of which a considerable number deal with power subjects. Of the many technical sessions there will be seven on power, five on fuels, eight on heat transfer, two on graphitization of piping, two on boiler feedwater studies and one on strength of pressure vessels, besides a number of others at which papers of general interest to the power engineer will be presented. These are scheduled as follows:

Monday, 8:15 p.m.

"Horizontal Cyclone Burner," by A. E. Grunert, Commonwealth Edison Company, Chicago; L. Skog, partner of Sargent & Lundy; and L. S. Wilcoxson, vice-president of Babcock & Wilcox Company.

"Determination of Moisture Content of Coal by Means of Pulverizer Heating Balance," by T. J. Finnegan and H. L. Smith, Buffalo-Niagara Electric Corp.

"Performance Data on Butterfly Valves," by S. Dushkes of Askania Regulator Company.

"Multiple Element Control Systems," by H. H. Gorrie, Bailey Meter Company.

"Application of Instruments to the Measurement of Rapidly Varying Flows of Gases and Liquids," by H. W. Stoll, Taylor Instrument Companies.

Tuesday, 9:30 a.m.

Panel Discussion on "Better Application of Combustion Equipment."

"A Fuel Engineering Study of Some Recent Boiler Installations," by J. E. Tobey, Fairmont Coal Bureau.

"Designing Coal-Burning Equipment to Eliminate Trouble Spots," by W. H. Rowand, Babcock & Wilcox Company.

"Fuel Economics Affecting Boiler Unit Design," by John Van Brunt, Combustion Engineering Company.

"Better Application of Combustion Equipment for Medium Industrial Plants," by Ollison Craig, Riley Stoker Corp.

"Better Application of Combustion Equipment for Small Industrial Plants," by T. A. Marsh, Iron Fireman Mfg. Company.

"Wartime Lessons in Coal Burning," by C. E. Miller, Office of Chief of Engineers, U. S. Army.

"Pulverized Coal for the Gas Turbine," by Martin Frisch, Foster Wheeler Corp.

"Future Trends in the Application of Coal-Burning Equipment," by F. W. Argue of Stone & Webster Engineering Corp.

Tuesday, 2:30 p.m.

"Corrosion-Erosion of Boiler Feed Pumps and Regulating Valves," by H. W. Wagner, J. M. Decker and J. C. Marsh, The Detroit Edison Company.

"Investigation of Acid Attack on Boilers and the Effect of Repeated Acid Cleaning on the Metal," by H. C. Farmer, Philadelphia Electric Company.

"Model Tests of Granby Pumps," by B. L. Vander Boegh, Newport News Shipbuilding & Drydock Company.

"Hydro Power in Wartime Germany," by A. Hoefle, Toledo Edison Company.

Tuesday, 8:15 p.m.

"Correction for Heat-Conduction Through Longitudinal Baffle of Heat-Exchangers," by A. M. Whistler, C. F. Braun & Company.

"Shell-Side Coefficients of Heat Transfer in a Baffled Heat-Exchanger," by H. S. Gardner, University of Rochester, and Irving Siller, The Pfaudler Company.

Wednesday, 9:30 a.m.

"Part-Load Characteristics of Marine Gas Turbine Plants," by W. M. Rohsenow, Massachusetts Institute of Technology, and J. P. Hunsaker of Jackson & Moreland.

"Some Effects of Pressure Loss on Open-Cycle Gas Turbines," by J. I. Yellott, Dir. Locomotive Development Committee, and Eric F. Lype, Illinois Institute of Technology.

"The National Fuel Reserves and Their Relation to Future Supply of Liquid Fuel," by A. C. Fieldner, U. S. Bureau of Mines.

"Factors Rarely Considered in Smoke Abatement," by H. F. Hebley, Pittsburgh Coal Company.

Wednesday, 2:30 p.m.

"The Value of Wet Compression in Gas-Turbine Cycles," by R. V. Kleinschmidt.

"Gas Turbines with Water Injection," by C. A. Norman, Ohio State University, and R. H. Zimmerman.

Thursday, 9:30 a.m.

"Recent Gas-Turbine Developments," by Dr. Adolphe Meyer, of Brown Boveri Company, Switzerland.

"A 2000-Hp Gas-Turbine Generator Set," by T. J. Butz, Westinghouse Electric Corp.

Second Boiler Feedwater Studies Session (final program not ready).

"Findings of the Co-operative Program of the Valve Manufacturers on Graphitization in Castings," by J. J. Kanter, Crane Company.

"A Report on Graphitization Studies in Philadelphia Electric Company's High-Temperature Welded Piping," by A. E. White, University of Michigan and E. L. Hopping, Philadelphia Electric Company.

"Progress Report on Pressurized Combustion of Pulverized Coal—Coal Preparation, Fly-Ash Removal and Introduction to Combustion," by J. I. Yellott, Dir. Locomotive Development Committee.

"Furnace Temperature Control of Large Steam Generating Units," by Otto de Lorenzi, Combustion Engineering Company.

Thursday, 2:30 p.m.

"Some Practical Applications of Flue-Gas Recirculation," by E. Durham and W. H. Rowand, Babcock & Wilcox Company.

"Clogging of Coal in Bunkers," by R. F. Legget, University of Toronto.

"Development of Steam Turbines for Main Propulsion of High-Powered Combat Ships," by G. B. Warren, General Electric Company.

"Continuation of the Joint E.E.I.-A.E.I.C. Investigation on Graphitization of Piping," by S. L. Hoyt, R. D. Williams and A. M. Hall.

"Influence of Postweld Heat-Treatment on Graphitization," by I. A. Rohrig and Arthur McCutchan, The Detroit Edison Company.

Friday, 9:30 a.m.

"Unfired Cylindrical Vessels Subjected to External Pressure," by F. V. Hartman, Aluminum Ore Company.

"Master Charts for the Design of Vessels under External Pressure," by D. F. Windenburg, U. S. Navy Dept.

"Calculating the Collapsing Strength of Vessels Subject to External Pressure," by R. G. Sturm and H. L. O'Brien, Purdue University.

Friday, 2:30 p.m.

"Precipitation-Hardened Alloys for Gas-Turbine Service," by Howard Scott and R. B. Gordon, Westinghouse Electric Corp.

"Materials for Power Gas Turbines," by C. T. Evans, Jr., The Elliott Company.

"Nickel-Chromium Alloys for Gas-Turbine Service," by C. A. Crawford, International Nickel Company.

Among the subjects of general interest will be a symposium Monday evening on "A Basic National Labor Policy". W. H. Davis, formerly of the War Labor Board, will act as chairman; speakers for Management will be Herman W. Steinkraus, president of the Bridgeport Brass Company and Lee H. Hill of McGraw-Hill Publishing Company; and those for labor will be Clinton Golden of C.I.O. and Frank Fenton of A.F. of L.

Several luncheon meetings will be held at which there will be talks by prominent individuals. At the Monday luncheon Carl Hinshaw, member of Congress, will talk on "The Public Responsibility of the Engineer"; Paul G. Hoffman, president of The Studebaker Corporation, will address the Tuesday luncheon on "The Outlook for Freedom"; at the Wednesday luncheon Philip Swain of *Power* will tell "What Happened at Bikini," where he was an observer; and the Thursday luncheon will be devoted to aircraft gas turbines, with Air Commodore Frank Whittle, R.A.F., as the speaker.

The annual banquet is scheduled for Wednesday evening at the Hotel Pennsylvania. At this time honorary membership will be conferred upon Lewis K. Sillcox and Professor A. G. Christie, past president of the Society.

Peak Loads Set New High

A new maximum of 39,352,000 kw was set by the aggregate of major electric utility system peak loads of September 1946, according to figures released on October 31 by the Federal Power Commission. This peak was 8.9 per cent higher than that for September last year and exceeded by almost a million kilowatts the previous maximum of 38,379,604 kw reached in August 1946. The highest prior total on record was 38,252,630 kw reached in January 1945 which was the wartime maximum. The corresponding energy consumption for September was 18,814,355,000 kwhr which was a gain of 10.6 per cent over September 1945. The greatest percentage increase, both in peak load and in output, was in the East Central States.

Combined utility and industrial production during September was 22,820,382,000 kwhr.

For the 12 months ending September 30, 1946, the report shows a total production for public use of 215,250,978,000 kwhr, and a combined utility and industrial production of 261,039,991,000 kwhr.

The total capacity of electric-generating plants in utility service as of September 30, is given as 50,189,566 kw and that of industrial power plant capacity as 12,762,176 kw. This includes steam, hydro and diesel.

Power in South Africa

"In South Africa the end of hostilities found the power supply industry handicapped by shortages of generating capacity and distribution equipment to meet the widespread demand for electricity by mining, industrial and domestic consumers," so states the recent Annual Report of the Electricity Supply Commission of the Union of South Africa. It would appear that the aggregate installed capacity in the main power stations owned by the Commission is approximately 873,000 kw, which figure will be increased to 1,086,000 kw when additional capacity under construction or on order is installed. The output for 1945 was 4,861,000,000 kwhr of which about three-fourths served mining operations. This represented an increase of about 7 per cent during the year.

The newest plant on the system is the Vaal Generating Station which when completed, will have 200,000 kw. Two 33,000-kw Metropolitan-Vickers turbine-generators and six boilers went into service early in 1945 and three Ljungstrom turbines of like capacity were expected to be operating by the end of the present year.

The statutory requirements of the Commission are that it operate, as far as practicable, with neither profit nor loss; to which end it is permitted to adjust charges for electricity from time to time. However, it did not increase its tariffs during the war period, and last year incurred a substantial deficit. As a consequence, the Report states that increased electric rates will be necessary during the ensuing year to meet rising material and labor costs. This will represent the first increase in nearly 20 years.

Welding Equipment for Thawing Frozen Water Pipes

Use of electric welding equipment to thaw frozen water pipes has been practiced successfully by a number of plant owners during the past few winters, according to R. F. Wyer of General Electric Company. Such equipment offers advantages over other electrical means because it is self-regulating and can be accurately controlled.

No special equipment is necessary for doing this work other than reliable pipe clamps for making firm electrical connections. Strap-type clamps of copper, having ample section to carry several hundred amperes, are desirable. C-clamps may be used to clamp cable terminals directly to the pipe where necessary. A file, rasp, or abrasive cloth may be used to remove zinc oxide, rust, paint, and grease to assure a good electrical contact.

Cable should never be wrapped around the pipe as a connection, since it is practically certain to loosen, and may cause hazardous sparking. Ordinary pipe wrenches are required for disconnecting piping. A portable voltmeter is useful for checking voltage drops and determining the continuity of circuits.

The connections to the welding generator are made in the ordinary way with the work lead and electrode lead both connected to the pipe on opposite ends of the frozen section so that the heat generated in the pipe wall by the passage of current will thaw the ice in the pipe. The method of getting at the pipe will vary in almost every case, but for economy, it is desirable to get as close to the frozen portion as is feasible without excessive digging in frozen ground. It is desirable to set the machine at the lowest current output adjustment at the beginning of a thawing interval in order to permit checking connections with the least liklihood of flashing.

While the proper current for thawing pipes has been established as between 200 and 500 amp, the time needed to complete the job varies greatly according to the size, length, kind and location of the pipe, condition of the surrounding soil, extent of the freeze, and temperature of the air. Mr. Wyer offers the values in Tables 1 and 2 as an aid in determining the various factors involved. While the resistances given are for direct current, the reactance is so small that it can ordinarily be neglected when the cables are not coiled.

When using arc-welding equipment for thawing purposes, there are a number of precautions which must be observed. If a good, low-resistance joint is not obtained between the copper cable and water pipe, excessive heat will be generated at the connection. If the current is allowed to form an arc at this point, it may damage the pipe.

Care should be taken to select the correct amount of current where there is known to be lead in the service pipe, because lead pipes will stand less current than iron. The pipes should be disconnected from the building piping before the wiring so that the current has only one path in which to travel—through the section which is frozen. If this is not done, where other devices are grounded to the water pipes the ground wires may burn out and cause a fire, since the grounding connections will be raised above earth potential.

In using single-operator d-c sets, two points should be noted. The low load voltage will result in the possibility of unusually heavy currents on the lower taps. Since these taps are designed to carry the low currents which will be drawn at normal operating voltages, the result may be to overheat portions of the series field. This can be avoided by setting the units on the highest tap and lowest open-circuit voltage which will give the desired current.

In addition, the low load voltage should be considered in making an estimate of the current setting required. Since load voltages in the neighborhood of 5 or 6 volts will often be encountered, the output current on any setting will be as much as $1^1/_2$ times the current which would be drawn by a welding arc. With transformers, however, the current drawn by the load will be very nearly that indicated on the nameplate.

As a final precaution, the resistance of the joints in the pipe should be determined. If the joints are insulated by rust or pipe dope, a spark may start a fire.

TABLE 1

Pipe Diameter in Inches	Recommended Amperes	Approx. Minutes to Thaw	Recommended Cable Size	Resistance per 100 Ft Cable
$^1/_4$	75	15	No. 6	0.0395
$^1/_2$	125	20	No. 2	0.0156
$^3/_4$	200	20	No. 0	0.00984
1	250	30	No. 00	0.00780
$1^1/_2$	300	30	No. 000	0.00619
2	350	40	No. 0000	0.00491
4	600	75	400,000 cm	0.00270
6	800	120	600,000 cm	0.00180

TABLE 2—OHM RESISTANCE PER 100 FT—STANDARD PIPES

Pipe Diameter	Wrought Iron	Steel	Copper Tubing	Lead	Cast Iron, Class A
$^1/_2$	0.026	0.0198	0.00824	0.0234	....
$^3/_4$	0.0202	0.01485	0.00445	0.01371	....
1	0.0138	0.0100	0.0034	0.00984	....
$1^1/_2$	0.00842	0.00618	0.00208	0.0064	....
2	0.00625	0.0046	0.00133	0.0053	....
4	....	....	....	....	0.0092
6	....	....	....	....	0.006

TABLE 3

Equipment	10 Volts	20 Volts	30 Volts	40 Volts
300-amp a-c welders	500 amp	450 amp	400 amp	375 amp
500-amp a-c welders	800 amp	750 amp	700 amp	625 amp
300 amp d-c welders	650 amp	600 amp	500 amp	400 amp
400 amp d-c welders	800 amp	750 amp	700 amp	600 amp
600 amp d-c welders	1200 amp	1000 amp	900 amp	700 amp

BOOK REVIEWS

Chemical Analysis of Metals

The 1946 Book of A.S.T.M. Methods of Chemical Analysis of Metals which replaces the earlier 1943 edition gives in their latest form the 35 extensive standards developed by the A.S.T.M. committees concerned with the analyzing of metals and their alloys. The greatly expanded volume, of 412 pages compared with the 1943 edition of 330 pages, includes not only modernized versions of the various older methods widely used throughout industry, but it includes several of the newer photometric methods and also spectrochemical methods of analysis for certain materials and elements.

There are recommended practices covering apparatus and reagents and photometric methods. The extensive methods of sampling and chemical analysis of steel, cast iron, wrought iron, etc., are included, together with methods of sampling and analyzing ferro alloys. A considerable portion of the new volume is devoted to nonferrous metals, including sampling, chemical analysis and photometric method covering aluminum, magnesium, copper, lead, lead and tin-base alloys, solders, zinc and nickel. Of the 35 standards seven pertain to photometric methods and five involve spectrochemical procedures. Sixteen of the 35 methods carry 1946 designations indicating they were either new this year or have been revised.

Bound in cloth 6 by 9 in. page size, the book sells for $4.50 in blue cloth binding.

Fuels, Combustion and Furnaces

By John Griswold

First Edition

This is essentially a textbook, written and arranged more particularly to meet the needs of students in chemical engineering. In fact, the author is professor of chemical engineering at the University of Texas.

The technology of fuels of various types both natural and manufactured, is adequately covered, as is also the theory of combustion processes. However, the attempt to cover fuel-burning equipment and steam generation has resulted in rather sketchy and incomplete treatment, insofar as current practice is concerned.

At the end of each chapter is a list of supplementary references and problems for the student.

There are 496 pages, 6 × 9 in., including an appendix with numerous useful tables. Price $5.50.

Obituary

Dr. Sanford A. Moss, widely known inventor of the turbo-supercharger for airplane engines and an authority on gas turbines, died suddenly of a heart ailment in Lynn, Mass., on November 10 at the age of 74.

As a young man, working as a machinist on the West Coast, Moss became interested in compressed-air machinery and subsequently entered the University of California from which he graduated with the B.S. degree in 1896. Four years later he was awarded his master's degree. He then went to Cornell University as a graduate student and instructor and earned his doctor's degree in 1903 with a thesis on the gas turbine. This led to his employment by the General Electric Company where, at the Lynn works, he subsequently devoted his entire time to development of the supercharger. This met with partial success in its application to the airplane during World War I and complete success with the advent of War II. During the war he was consultant to the Army Air Force and later retired from active work.

Arthur L. Rice, Editorial Director of *Power Plant Engineering* died in Wilmette, Ill. on November 10 at the age of 76.

A graduate of Worcester Polytechnic Institute in 1890 with the degree of B.S. in engineering, he received a Masters degree from Cornell University in 1896. Following several years in the field of teaching, he became editor of *The Engineer* in 1904. When that publication was merged into *Power Plant Engineering* in 1908 he was made editor of the latter which position he held for nearly 30 years, becoming editorial director when his health made it necessary for him to give up the more arduous duties. Mr. Rice was at one time a vice president of the A.S.M.E.

Personals

S. A. Newman, turbine lubrication specialist recently released from service as a captain in the U. S. Navy, has been appointed chief turbine lubrication engineer by the Gulf Oil Corporation.

Prof. Aubrey I. Brown has been appointed head of the mechanical engineering department at Ohio State University, succeeding **Prof. Franklin W. Marquis** who has resigned the chairmanship of the department in order to devote his full time to teaching.

William Ferguson, long identified with the Travelers Insurance Company of Hartford, Conn., has been appointed chairman of the American Uniform Boiler-Law Society with headquarters in New York. He succeeds Charles Gorton who retired on October 1.

Clarence Johnson, after 18 yr as research engineer with Bailey Meter Company, has established an office at Beloit, Wis., as research consultant on inventions and engineering developments.

J. P. H. Perry, vice president of the Turner Construction Company, New York has been re-elected president of the United Engineering Trustees.

Harry A. Reed has been elected vice president of Day & Zimmerman, well-known Philadelphia engineers. He will be succeeded as engineering manager by **Thomas W. Hopper.**

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